CHAPTER-10

LEXICON–BASED APPROACHES FOR SENTIMENT CLASSIFICATION

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ABSTRACT

As social media has become an important part and package in everyone's daily life. Human emotions are persistently being expressed in real time on various social networking platforms. The availability of a gigantic amount of opinion-rich data from various social networking platforms has fueled interest in opinion mining and sentiment analysis. Applying mining techniques and sentiment analysis over big data (unstructured) is considered a great challenge in the sentiment analysis research area. There are mainly following methodologies for performing sentiment analysis that is machine learning-based approach, the lexicon-based approach and hybrid approach. In this paper, we chose to limit our study to just the lexicon-based approach of sentiment anal Lexicon-based based approach relies on the lexicons for categorizing input A lexicon is a set of words, idioms, phrases, etc. having a semantic meaning. In this paper, earlier research done in lexicon-based sentiment analysis has been studied; also, are view of some state-of-the-art lexicon-based solutions has been presented for polarity classification of Sentiment Analysis. This paper is mainly oriented toward the various lexicons used for polarity classification.

Keywords: *Opinion mining, sentiment analysis, Big data, machine learning, lexicon and hybrid approach.*

INTRODUCTION

A huge amount of data that exist in social network platforms is unstructured. This is difficult to analyze and gain valuable insights from such unstructured/Big data. Sentiment analysis or opinion mining is a very important practice, which helps in detecting emotions and opinions on social media data. This can help in solving many problems and provide many indicators in a public opinion survey, public satisfaction, and election opinion polling.

Sentiment analysis has become a popular research area these days. Opinion mining has routed its way into the present world by helping people to analyze learning-based review. The study of outlooks and sentiments of the people is called sentiment analysis. Sentiment analysis is one illustration of text mining and in a text mining work- flow/same kind of work-flow is followed. Some input data is read, next comes the enrichment part some additional information is added to the input document in form of tags. Those added tags work as a label for each word, a dictionary for positive words and a list or dictionary for negative words is used. The tagged words in input document are segregated into positive and negative lists according to the dictionary. The words which did not have any tags are deleted. After performing the above steps, finished rules are obtained. Now we can actually evaluate how good our rule-based approach is. We have chosen to restrain our study in this paper to only lexicon-based technique for sentiment analysis. Lexicon-based approach is the top choice when dealing with messy data/Big Data; despite limited time and resources.

The rest of the paper is divided in following section: In Section2, an overview is provided about natural language processing and sentiment analysis. In Section3, a discussion on its prior work is done. In Section4, lexicon- based approach is discussed in detail. In Section5, brief evaluation of some popular lexicons is done. Finally, in Section6, we have concluded our work.

AN OVERVIEW OF NLP AND SENTIMENT ANALYSIS

A. Natural Language Processing(NLP): It is known that humans are most advanced community on earth and our achievement as humans is due to our ability to convey and share information, the sub field of artificial intelligence called NLP is focused on enabling computers to understand, interpret, manipulate and communicate etc. in human language. In other words, NLP is an AI approach of communicating and connecting with an intelligent system using human like language. Utmost of the data produced all over the web is unstructured; and most of this data is textual data, which is amorphous, and difficult to deal with algorithmically. So, in order to produce significant suitable insights from textual data, it is important to get familiar with text analysis. Text analysis/text mining and natural language processing go hand in hand. Text mining refers to process of obtaining most relevant high-quality significant information from text. The process involves structuring input data, then originating patterns from it and finally estimating obtained output. NLP is applicable in various fields like text generation, topic modeling, speech recognition, etc. Sentimental analysis is one such field where NLP is heavily used.

B. The Necessity of Sentiment Analysis(SA): It is observable that Science can be visualized as an image of society; existing world imposes coin age of new research areas. One of the fastest growing research areas under NLP is the use of text mining; Which means to analyze sentiments from given data.

Sentiment analysis is the process of defining positive or negative or neutral feeling through text. Communication is essential for society, as it helps them to fulfill their emotional needs. People in leaps and bounds have started expressing their opinions on various social media. Day and night people keep on posting their experiences and opinions related to products, restaurants, places, persons, things, politics, social issues and much more. People express each and every emotion on various social media. To get the right directions and to take the best decisions company owners, manufactures, politicians etc., across world are acute to know opinions of the societies, therefore mining such opinions from the text that is SA thus becomes important.

C. Design involved in Sentiment Analysis: As it is mentioned that sentiment analysis is all about expressing opinions towards any subject, while it is known that opinion refers to the view points, subject refers to the target for an opinion and emotions implies the state of mind of a person.

- Initial step is to discover the subject towards which feeling or emotion is focused.
- After identifying the subject, polarity of the emotion is considered.
- Finally, the intensity of the sentiment words is calculated by allocating them the sentiment scores.

D. Brief summary of Lexicon Based approach (LBA) and Machine Learning approach (MLA): It is known that SA is usually obtained using LBA or MLA. Both the approaches have their pros and cons. Legislator is all about train, test and then implement the strategy. In simple terms, MLA requires a training data set for the training algorithm, with distributed inputs and their known outputs. This is done before they are applied to real data, so that they work well with new unknown data. For example: "I am not happy", MLA would classify it as negative because the bigram "not happy" is a negative coded by humans. Despite its many advantages, it also has some drawbacks; the method requires a large set of training data as well as test data. Algorithm training is time consuming and also expensive method; it requires massive resources to function. Machine learning performance depends on how well the training and test data

match. Inadequate training or training with a small set of data can produce biased or incorrect results.

RELATEDWORKS

The researches done in LBA for Sentiment analysis have been studied and findings are presented below. A lexicon of Sinhala Language using corpus-based approach is proposed. It was found that the made framework will be more precise with bigger text corpus and obtained accuracy is 69.23% [i].

A Sentiment lexicon named CP-chunks is proposed. It aims at dealing with vagueness of lexical sentiments and is based on lexicon-based technique. LMRD and MRD dataset have been used. FCP-Lex obtained an accuracy of 82%. Also, it was found that the constructed lexicon is more effective in analyzing sentiments [ii]. The point in study was to develop an LBA for analysis of sentiments on faculty evaluation feedback given by students at end of course to deal with the open-ended questions based on unigrams. 1,748 feedbacks were collected. Results show that score of sentiment is akin to Likert scale-based score. Accuracy obtained is 91.2% [iii]. The point in study was to analyze sports related twitter communication using LBA. It is demonstrated that analyzing sentiments can proved to be good and effective and for sports content and it is deliberate to simulate discussion on Sentiment analysis in sports science. Accuracy obtained is 95% [iv].

The point in study was to develop a WKWSCI Sentiment lexicon and compare its performance with the other five previously developed lexicons. This newly made lexicon has an accuracy of 69% [v].

Researchers have proposed an approach for finding word polarity using dictionary-based method and extraction of feature technique. Results implies that feature extraction perform better than dictionary-based methods. Accuracy obtained is 81% [vi]. In this, a tool to evaluate Arabic social content was developed based on LBA approach and POS tagging. Performance evaluation shows that tool gives more exact results, when applied to reviews which are Arabic and are domain based. 93.9% accuracy was obtained using this tool [vii].

Emotion Analysis Platform (EAP) is proposed to be applied on Weibo to monitor the emotional pulse of China using fine grain emotions technique. 35,000 tweets of Sichuan earthquake were collected. EAP is efficiently applied to capture the emotional pulse from dimension of time and space. EAP obtained 80% of accuracy [viii]. In this paper, Sentiment Analysis of online paper (SAOOP) is proposed to help researchers analyze online paper reviews using enhancement BOW model. Obtained results show that SAOOP is good for selecting efficient papers, it also evaluates topic domain parameters of scientific papers to evaluate total score of paper, and alsoit obtained an accuracy of 82.5% [ix].

EXPLORING LEXICON BASED METHODFOR SENTIMENT ANALYSIS

Lexicon-based approach depends on the words in the text and the sentiment they carry. Summary of such polarities is done using NLP and linguistic rules are used to calculate sentiment from the given text. This technique uses Natural Language Processing concepts and a dictionary to extract the attitude of the conversation.

A. There are two norms related to sentiment-basedpolarity classification:

- Prior polarity of terms is assigned independent ofcontext.
- Prior polarity is expressed using numerical value.

With respect to these notions lists of words can be generated with their antecedents, these lists of words are known as sense lexicons. SA begins with the construction of a lexicon using lexicon-based methods or emotion polarity detection in a piece of text using some pre- existing lexicon or a combination of both. As we can appreciate that creating and validating a dictionary manually is not very easy, it is quite a time consuming task and that is the reason why there are only a few popular dictionaries and most people use them or a combination of them. Let's use. , In other words, lexicon can be termed as the linguistic approach that associates words with emotional polarity such as positive, negative or neutral polarity and their numerical scores indicate their emotion strength. Most dictionaries are general-purpose dictionaries and are not designed for any specific application; hence they can be applied in diverse domains.

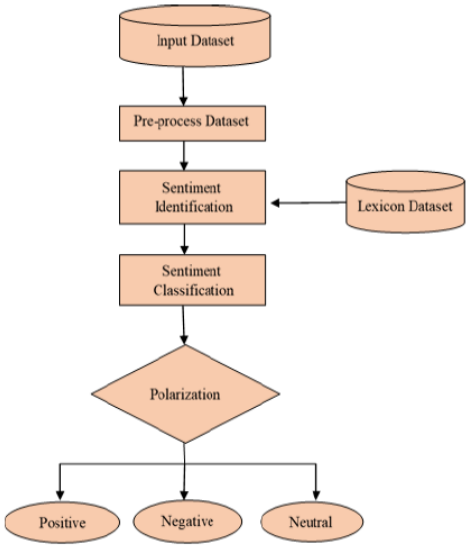

Fig.1. Framework of Sentiment Analysis using lexicon-based approach.

A framework showing the general steps followed for dictionary based sentiment analysis is given below, see

Figure 1 First and foremost task is to select the lexicon, it can be a pre-existing lexicon or a newly created lexicon and then dataset/documents are inserted, preprocessing and enrichment is done on it. Using a sentiment lexicon, a prior polarity is associated with each word in the document that falls under subjectivity detection. Sentiments core calculation is done through prior polarity and it is generated to give back the polarity and aggregated for the decision of polarity which is sentiment class (positive, negative or neutral).

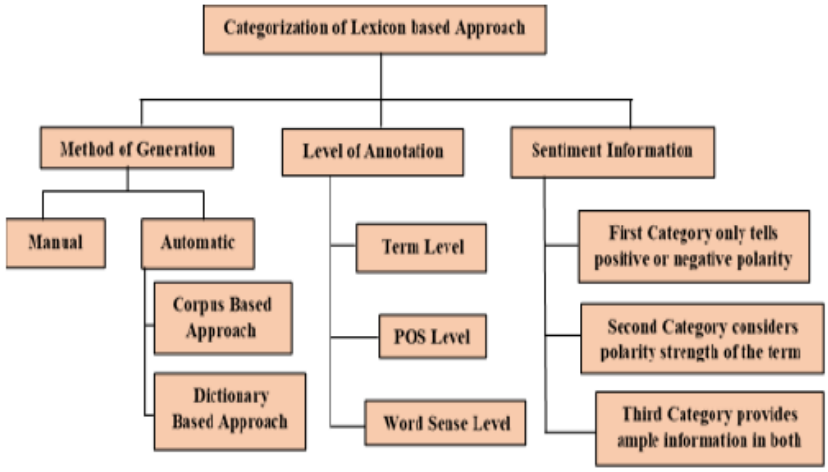

Fig.2. Categorization of Lexicon bases Approach

B. Method of generation of Sentiment Lexicons

There are three methods of sentiment lexicon generation. One of them is manual and other two are automatic refer figure.2. To create dictionary manually we need group of social scientists, psychologists, and experts etc. who do core knowledge soon based on their language understanding to manually collect opinion words. Although manually created dictionaries are more accurate, the process is very time consuming, and they also have relatively short period coverage. It's always a good idea to combine this approach with an automated approach. Example: Opinion Lexicon, GI etc. Automated approaches are corpus based approach (CBA) and dictionary based approach (DBA).

Some popular dictionaries are used in DBA, for example WorldNet, it starts with a set of some short sense words. It is then extended by finding words with opposite meanings, words with similar meanings and phrases from the dictionary. This is an iterative process; we keep adding new words. The dictionary obtained will be more general purpose, therefore not domain specific, which means the DBA is not very good at identifying the context specific sense. Example: SentiWordNet, SenticNet, WordNetAffect etc.

Another way of automated method is CBA. To generate a sentiment lexicon some sort of co-occurrence relationship is used to find the sentiment polarities of the word. It's asort of filling in the gaps that DBAs can't do well, so they can be tailored to certain domains, which means they make up for DBAs' lack of ability to handle context specific classifications of opinion words. This approach uses some kind of labeled data. A seed set of opinion words with known polarity is used. Syntactic patterns are used to find new opinion words, the polarity of opinion words in the corpus. DBA is more efficient than CBA, because CBA alone cannot identify all the sentiment words as maintaining and maintaining a corpus containing all sentiment words is a difficult task.

C. Classification of dictionaries on the basis of the amount of information given by them:

- First category dictionaries give information about words only about positive or negative polarity, the polarity strength of the words is not considered. For example, good and best would be considered similar in sentiment as both have a positive valence. Example: MPQA

Subjectivity Lexicon, GI, Opinion Lexicon.

- The second category is one that considers the polarity strength of words, for example using a Likert scale from 1 to 5 in either a positive or negative dimension. The major drawback is that when the term is unable to reach the maximum score, it is often ambiguous to decide whether the left-over score implies objectivity or the opposite polarity. Example: SentiStrength.
- The third category of the dictionary is the category that provides sample information about emotion in both positive and negative dimensions. Example: SentiWordNet.

D. Level of annotation in Sentiment Lexicons

These are linguistic properties that influence the assignment of scores in the lexicon. POS refers to the grammatical type of the tag word. For example: verb, noun, adjective, adverb, article etc. POS indicates how a word functions in meaning as well as grammatically within a sentence. A word can have multiple pos which are used depending on the context or word meaning. There are three levels of viewing the sentiment lexicon, see Figure 2.

- Term level
- POS level
- Word Sense level

Polarity is associated with words at the word level. This level is not good as the other two levels can change based on POS or word meaning. While at POS level, dictionary annotation is determined at grammar level. Annotations are determined based on the understanding of words at the word understanding level.

E. Prominent drawbacks of Lexicon Based Approach

It is also important to highlight some of the drawbacks of lexicon-based approach:

- The first drawback is that they are unable to process acronyms, initialisms, emoticons, slang etc. These are things that are part and parcel of our everyday interactions. Dictionary based approach is unable to process this type of spoken language.
- Most lexicons do not consider the type of words as a factor of intensity. For example: Sentiment lexicon, sentiment intensity are unable to account for eg, good and exceptional have the same score.
- Lexicons are unable to deal with sarcasm. Processing sarcasm requires a high level of intelligence and the LBA is not good at processing sarcasm.
- While using lexicon for SA, it is necessary that the dictionary should be kept updated, creating, updating and maintaining dictionaries takes a lot of time. If the dictionaries are not kept updated,the performance of the dictionaries gradually degrades.
- Question type sentences contain sentiment words, but they do not express any sentiment. For example: Who is mad? Doesn't have any sentiment. It becomes difficult to deal with such sentences.
- The sentences which do not contain sentiment words, their meaning can also be sentiment. Sometimes the words express some sentiment, but are not present in the dictionaries. For

example, the stock market these days is like a rollercoaster.

- Question type of sentences does contain sentiment words, but they don't express any sentiment. For example: Who is mad? Does not imply any sentiment. Dealing with such sentences becomes tedious.
- Sentences not containing sentiment words can also imply sentiment. At times, words do express some sentiments but are not present in the lexicons. E.g., Stock market is like rollercoaster these days.
- It is known that the domain greatly influences the score that is assigned to the word. A word may have opposite meanings in different domains; at most each domain specific word does not exist in the general dictionary, leading to miscounting of words. Sentiment can vary by domain; For example: In the long run product reviews may have a positive sentiment like the battery lasts longer. On the other hand, the queue for parcels is long; here long time has a negative connotation.

EVALUATION OF SOME POPULARSENTIMENT LEXICONS

This section provides an overview of some widely usedsentiment lexicons.

A. Opinion Lexicon(HuandLiu,2004)

- Hu and Liu developed a general-purpose sentiment lexicon, which classifies the English words into two categories that is positive words and negative words.
- It contains nearly 6,800 words out of which about 2,006 words classified as positive and 4,783 words as negative respectively.
- This polarity-based lexicon has evolved over several years, based on customer reviews from different domains.
- There is no part of speech tagging in this lexicon.
- Though it is applicable to social media text and product review. But lack of initialisms, emoticons, acronyms decreases its performance for sentiment analysis.

B. LIWC(Linguistic Inquiry and Word Count)

- LIWC pronounced as "Luke", classifies words into psychologically meaningful categories.
- It is a high quality, comprehensive lexicon and a text analysis program mainly used in psychology for inspecting the psychological perspective.
- The Sociologists, linguists and psychologists have been working with LIWC.
- It is an extensively validated lexicon; therefore people from different domains find it appealing.
- It's simple word lists and easy to understand dictionary make it an attractive option to use to extract emotional polarity from text; also it is easy to understand, inspect and extend if needed.
- This lexicon has eighty language categories and it comes under semantic orientation (polarity-based) lexicons.

- It is known that language plays a chief role in understanding a person's state of mind. It was found that LIWC is very good at identifying emotion in the language use.
- In spite of the benefits, this lexicon has some limitations also. Initialisms, emoticons, slang words, acronyms which are very important for opinion mining is ignored.
- Also this lexicon is unable to distinguish between sentiment intensity of the words, for instance: "This book is good" and "This book is amazing" both sentences will be assigned equal score by LIWC, as both of them contain one positive word each.

C. General Inquirer(GI)

- GI is a word-affect association, having a flavor of categories.
- By word-affect it is meant that a word is associated with affects or some words do have multiple senses.
- GI is used as a gold standard and there are about 11,896 entries with about 190 attributes related to sentiments and affects.
- This lexicon has two valence categories: About 1,915 words are of positive outlook and 2,291 words are of negative outlook.
- GI is one of the oldest manually created lexicons and is used by various scientists, researchers for objectively finding particular characteristics in messages like sentiment properties of text.
- Its two prime sources for tag categories is Harvard IV-4 dictionary and the Lass well value dictionary. Recently newly constructed categories are also added like "marker" categories for disambiguation.
- GI has no limit on the number of categories it can deal with, also each category is assigned a unique name. Name of the category is case sensitive; but has no restrictions on the length of name.
- To distinguish the Harvard dictionary category from similar Lass well dictionary category. '@' sign is appended to represent the former category and "Lw" is appended for the latter category. Other than this marker categories are represented in uppercase.
- Mainly GI finds its application in social science content analysis, but can also be applied to other domain like sentiment analysis also.
- Absence of emotion relevant lexical features, inability to differentiate between intensity of opinionated words affects its performance.

D. VADER (Valence Aware Dictionary for Sentiment Reasoning)

- VADER is a gold standard lexicon for English Sentiment classification and has been validated by human beings.
- It is based on rules with the mélange of qualitative and quantitative methods specifically attuned for sentiment analysis in tweet like data.
- This lexicon is large in size, quick, simple, easily understood, parsimonious and applied without extensive training, also it is easy to modify and extend if needed without compromising accuracy.

- It is applied extensively in social media domain, but it can be generalized and performs well in other domains as well.
- It not only gives the polarity score but also describes how positive or negative express opinion in input data.
- It also considers the boosting words; if boosting words like very, extremely etc. are present in the input text then its valence is increased. Also, valence is boosted by the presence of capital words, phrases, idioms etc.
- Range of normalized valence is between -1 and 1. The valence less than 0 and -1 is for negative, valence 0 is for neutral and valence greater than 0 and up to 1 is for positive polarity.

E. SentiStrength

- SentiStrength has an extended sentiment dictionary covering a variety of data coming from social websites such as Myspace, BBC, Digg and Runners World etc.
- It has been being tested on six different social media data sets; hence it is quite robust and an accurate in sentiment classification. It can detect positive and negative sentiment strength in micro blogs easily and has a near human accuracy.
- The output score provided by the SentiStrength is in the range of 1 to 5, whereas 1 and -1 represents weakest positive and the weakest negative emotion respectively.
- Whereas 5 and -5 corresponds to the strongest emotion both positive and negative respectively.
- SentiStrength works well with short text like micro blog like content, but is not good at dealing sarcasm.

F. SenticNet

- SenticNet is a popular publicly available semantic lexicon, mainly used for aspect level SA.
- This lexicon is based on semantic web techniques and artificial intelligence.
- Using this SA is performed on both syntactic and semantic level, also it uses dimensionality reduction concept to find common sense concepts polarity.
- It has around fourteen thousand two hundred twenty-two common sense concepts along with the information related to polarity, sentimental and semantic associations.
- SenticNet 5 has three levels of semantic networks that is primitive level, concept level and the entity level. In first level, actions and basic statics are defined with help of primitives. While level two deals with interconnection of common-sense concepts via semantic relationships and level three is comprised of named entities that are connected to common sense concepts.

G. SENTIWORD NET 3.0

- SentiWord Net is an affective lexicon resource made on basis of WordNet in English.
- It is one of the widely used lexical resource and is made up of synsets i.e., sets of synonyms. Every synsets has a score in range 0 to 1 and total is 1.0for every synsets.

- Positive score is for positive valence and negative score is for negative valence. Scores are assigned using classifiers trained on three WordNet sub sets i.e., positive, negative and neutral synsets.
- This lexicon is not a gold standard resource, it is very noisy in nature and even many of synsets have no positive, negative polarity. It also lacks sentiment carrying lexical features.
- But this lexicon is interesting as it gives positive and negative polarities of terms for different senses and at a deeper level word sense.

Table 1. A Concise Summation of Survey of WorkDone on Lexicons

Author and Year	Technique Used	Domain Oriented	Lexicon Type Usedand DataSet
Chetan andAtul (2014)	Lexicon Based Technique	Yes	6,74,412 tweets 560 Chinese Review
Mohammedet al. (2014)	Lexicon Based Approach based on POS tagging	Yes	Domain Oriented Lexicon Data set of Chat
Duyu et al.(2014)	Fine grain emotions	Yes	Chinese lexicon35,000 tweets of SichuanEarthquake
Doaa et al.(2015)	Enhancement BOW model	Yes	New Lexicon Three Datasets of around11,500 tweets
Quratulain et al. (2016)	Unigrams-based lexicon-based technique	Yes	MPQA 1,748 Feedback reviews by students
Deepali et al.(2016)	Context Oriented Lexicon	Yes	Hindi SentiWordNet5,200 reviews from movieand hotel domain
Khoo et al.(2018)	Lexicon Based Technique	No	WKWSCI Lexicon Amazon Product Review
Deepa et al.(2019)	Machine Learning and Lexicon based technique	Yes	SentiWordNet,VADER Twitter US Airline data set
Chathurangaet al. (2019)	Machine Learning and Lexicon based technique	No	Senti Word Net 3.0 Sinhala News Corpu s
Yin et al.(2020)	Lexicon Based Technique	Yes	Lexicon FCP – LexLMRD and MRDdataset
WunderlichandDaniel (2020)	Lexicon BasedAppro ach	Yes	LIWC, QDAP dictionary, Sentic Net 4 Lexicon10,000 tweets

CONCLUSION

The availability of a huge amount of opinion rich data from various social media platforms has fueled the interest in opinion mining and sentiment analysis. It is known that sentiment analysis is mainly performed using machine learning approaches and dictionary-based approaches. The point of study in this paper centers around the vocabulary- based method for sentiment analysis. It is a linguistic approach in which prior word polarities are extracted from lexical resources and summation of such polarities is performed using NLP and linguistic rules to compute sentiment from the given text. Dictionaries can be classified using a number of factors. In this paper, lexicons are classified based on three factors, namely, the method of generation of the sentiment lexicon, the information (polarity, strength or both) of the sentiment, and the level of annotation in the sentiment lexicon. This paper conducts a survey study on prior research done in lexicography-based sentiment analysis. Furthermore,

this paper has attempted to bring an overview of some terminology-based solutions for polarity classification for analyzing sentiment. Applying these dictionaries to datasets will promise to further expand our wings in this area and also expand the systematic literature review circle on a larger scale with future research.

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